SELECTING THE PROPER
FLANGED HEATER

A Tempco Selection Guide

TEMPCO

5 STEPS FOR SELECTING THE PROPER **FLANGED HEATER**

Flanged Immersion Heaters are designed for use in tanks and pressurized vessels to heat both liquids and gases. They connect to a separate flange that is either welded to a tank wall or welded to a pipe for circulating type heaters. The next few pages will describe both standard and optional materials and features available to meet the requirements of your application.

1 - DETERMINE A SAFE AND EFFICIENT ELEMENT WATT DENSITY

Element Watt Density is the wattage dissipated per square inch of the element sheath surface and is calculated with the following formula:

$$\text{Watt Density} = \frac{\text{element wattage}}{\pi \times \text{element dia.} \times \text{element heated length}}$$

For a particular application, element watt density will govern element sheath temperature. Factors to consider when choosing a suitable watt density are:

1. Many materials are heat sensitive and can decompose or be damaged if the element is running too hot.
2. Air and other gases that are poor conductors of heat require watt densities matched to the velocity of the gas flow to prevent element overheating.
3. When heating hard water and cleaning solutions, mineral deposits can build up on the element sheath, acting as a heat insulator and raising the internal element temperature. If these deposits cannot be periodically removed, use a lower watt density element to increase heater life expectancy.

2 - DETERMINE PRESSURE-TEMPERATURE RATING OF FLANGE REQUIRED

Pressure-Temperature Ratings Class 150-LB (Pressure in PSIG)

	Temperature °F (°C)													
Flange Material	-20 to 100 (-28.9 to 37.8)	200 (93.3)	300 (148.9)	400 (204.4)	500 (260.0)	600 (315.6)	650 (343.3)	700 (371.1)	750 (398.9)	800 (426.7)	850 (454.4)	900 (482.2)	950 (510.0)	1000 (537.8)
A105 Steel	285	260	230	200	170	140	125	110	95	80	–	–	–	–
316 Stainless	275	240	215	195	170	140	125	110	95	80	65	50	35	20
304 Stainless	275	235	205	180	170	140	125	110	95	80	65	50	35	20

Note: For heaters with a higher Pressure-Temperature Rating, consult Tempco.

3 - SELECT THE ELEMENT SHEATH MATERIAL

In addition to selecting a sheath material that is compatible with the heated medium, other factors that affect corrosion need to be considered:

1. ***The temperature of the corrodent*** – As temperature increases the degree of corrosion increases. Also remember that usually the element temperature is higher than the material it is heating.
2. ***The degree of aeration to which a corrodent is exposed –*** Stagnant conditions can deprive the stainless steels of oxygen, which is required to maintain their corrosion resistant surface.
3. ***The velocity of the corrodent –*** Increased velocity can increase the corrosion rate.

STANDARD ELEMENT SHEATH MATERIALS

Incoloy® 800

A Nickel (30-35%), Chromium (19-23%), Iron alloy. The high nickel content of this alloy contributes to its resistance to scaling and corrosion. Used in air heating (also see Incoloy® 840) and immersion heating of potable water and other liquids that are not corrosive to an Incoloy® 800 sheath.

Low Carbon Steel

Applications include fluid heat transfer media, tar, high to low viscosity petroleum oils, asphalt, wax, molten salt, and other solutions not corrosive to a steel sheath.

Copper

Mainly used in clean water heating for washrooms, showers, rinse tanks and freeze protection of storage tanks.

316 Stainless Steel

A Chromium (16-18%), Nickel (11-14%), Iron Alloy with Molybdenum (2-3%) added to improve corrosion resistance in certain environments, especially those that would tend to cause pitting due to the presence of chlorides. Applications include deionized water.

OPTIONAL ELEMENT SHEATH MATERIALS

304 Stainless Steel

A Chromium (18-20%), Nickel (8-11%), Iron Alloy used in the food industry, sterilizing solutions, air heating and many organic and inorganic chemicals.

321 Stainless Steel

A Chromium (17-20%), Nickel (9-13%), Iron Alloy modified with the addition of titanium to prevent carbide precipitation and the resulting intergranular corrosion that can take place in certain mediums when operating in the 800-1200°F (427-649°C) temperature range.

Incoloy® 840

A Nickel (18-20%), Chromium (18-22%), Iron alloy. Incoloy 840® has about 10% less nickel than Incoloy 800. Used in many air heating applications where it has exhibited superior oxidation resistance at less cost than Incoloy 800®.

Incoloy® 825

A Nickel (38-46%), Chromium (19.5-23.5%), Molybdenum (2-3%) Iron alloy. Consult Tempco for more information.

Note: See catalog pages 16-12 through 16-20 for the recommended sheath materials for many immersion heating applications.

SURFACE TREATMENTS TO IMPROVE CORROSION RESISTANCE

For Stainless Steel and Incoloy® Elements and other Wetted Parts

Flanged Immersion Heater surfaces in contact with the material being heated can be passivated or electro-polished to improve their resistance to corrosion.

Passivation

Passivation removes surface contamination, usually iron, so that the optimum corrosion resistance of the stainless steel is maintained. Surface contamination would come from the small amount of steel that may be worn off a tool during the manufacturing process. Passivating is accomplished by dipping the heater in a warm solution of citric acid.

Electro-Polishing

Electro-Polishing is an electrochemical process that removes surface imperfections and contaminants, enhancing the corrosion resisting ability of the stainless steels. The resultant surface is clean, smooth and bright. Many medical and food applications require this finish.

4 - SELECT OPTIONAL FLANGE AND GASKET MATERIALS

FLANGE MATERIALS

Optional flange materials include:

- **304, 304L Stainless Steel**
- **316L Stainless Steel**
- **Incoloy® 800**

GASKET MATERIALS

Gaskets of different types are available to properly seal any flanged heater. Tempco offers a compressed fiber Duron 8500 gasket which offers excellent sealability, compressibility, recovery, and flexibility. Duron 8500 gaskets contain high-grade aramid and inorganic fibers bonded with high-grade nitrile (NBR) rubber. Gasket material choice depends on operating conditions and fluid compatibility. Consult Tempco for help with your selection.

5 - SELECT STANDARD TERMINAL HOUSING

If the housings on the following pages do not meet the size, construction or other criteria of your application, consult Tempco with your requirements.

Standard catalog flanged immersion heaters are supplied with the general purpose Type 1N (NEMA 1) terminal housing as shown on the next page. If an optional thermostat is installed, the housing supplied is the Type 1T (NEMA 1). See catalog pages 11-6 through 11-10 for thermostats and accessories.

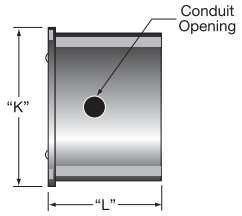
ADDITIONAL HOUSING TYPES (FOR USE WITH OR WITHOUT A THERMOSTAT)

- **Moisture Resistant (NEMA 4)**
- **Explosion Resistant (NEMA 7)**
- **Moisture/Explosion Resistant (NEMA 4/7)**

STANDARD NEMA 1 TERMINAL HOUSINGS FOR ALL SIZE FLANGES

TYPE 1N

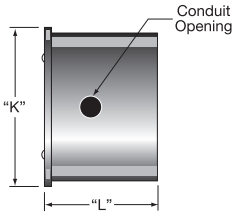
(for use with heaters having no thermostat)



Flange Size	"K" (in)	"K" (mm)	"L" (in)	"L" (mm)	Conduit Opening
3	4-1/8	105	3-1/16	78	1-1/8
4	6	152	4	102	1-1/8
5	6-3/8	162	4	102	1-1/8
6	7-13/16	198	5-3/8	137	1-1/8
8	9-7/8	251	5-3/8	137	1-3/8
10	11-3/4	298	6	152	1-3/4
12	13-3/4	349	6	152	1-3/4
14	15-1/4	387	6	152	1-3/4

TYPE 1T

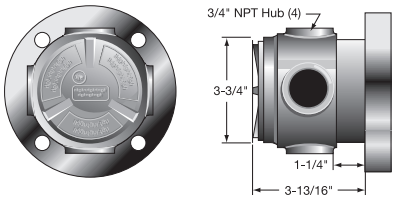
(for use with heaters with a thermostat)



Flange Size	"K" (in)	"K" (mm)	"L" (in)	"L" (mm)	Conduit Opening
3	4-1/8	105	6	152	1-1/8
4	6	152	6	152	1-1/8
5	6-5/8	168	6	152	1-1/8
6	7-13/16	198	6	152	1-1/8
8	9-7/8	251	6	152	1-3/8
10	Call Tempco				
12					
14					

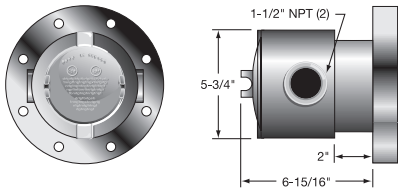
STANDARD NEMA 4 AND/OR 7 TERMINAL HOUSINGS FOR 3" FLANGES

NEMA 4 rating requires the use of the cover gasket.



TYPE 2N

(for use with heaters having no thermostat)

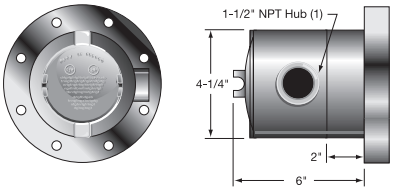


TYPE 2T

(for use with heaters with a thermostat)

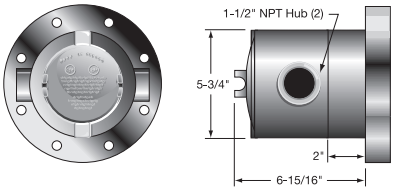
STANDARD NEMA 4 AND/OR 7 TERMINAL HOUSINGS FOR 4" AND 5" FLANGES

NEMA 4 rating requires the use of the cover gasket.



TYPE 3N

(for use with heaters having no thermostat)



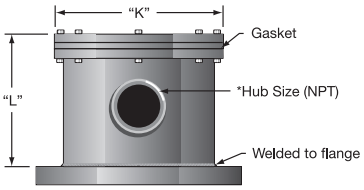
TYPE 3T

(for use with heaters with a thermostat)

STANDARD NEMA 4 TERMINAL HOUSINGS FOR 6" THROUGH 14" FLANGES

TYPE 4N

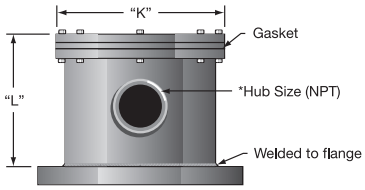
(for use with heaters with no thermostat)



Flange Size	"K" (in)	"K" (mm)	"L" (in)	"L" (mm)	Hub Size (NPT)
6	8	203	6	152	2
8	10	254	6	152	2
10	13-3/4	349	6	152	2-1/2
12	15-5/8	397	6	152	2-1/2
14	17-1/4	438	6	152	2-1/2

TYPE 4T

(for use with heaters with a thermostat)

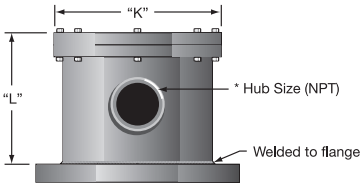


Flange Size	"K" (in)	"K" (mm)	"L" (in)	"L" (mm)	Hub Size (NPT)
6	8	203	6	152	2
8	10	254	6	152	2
10	13-3/4	349	7-1/2	191	2-1/2
12	15-5/8	397	7-1/2	191	2-1/2
14	17-1/4	438	7-1/2	191	2-1/2

STANDARD NEMA 7 TERMINAL HOUSINGS FOR 6" THROUGH 14" FLANGES

TYPE 5N

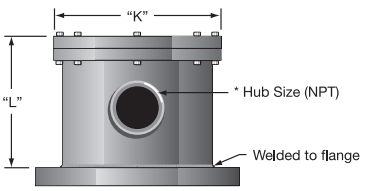
(for use with heaters with no thermostat)



Flange Size	"K" (in)	"K" (mm)	"L" (in)	"L" (mm)	Hub Size (NPT)
6	9-3/8	203	6	152	2
8	11-1/2	254	6	152	2
10	13-3/4	349	6	152	2-1/2
12	13-5/8	397	6	152	2-1/2
14	17-1/2	438	6	152	2-1/2

TYPE 5T

(for use with heaters with a thermostat)



Flange Size	"K" (in)	"K" (mm)	"L" (in)	"L" (mm)	Hub Size (NPT)
6	9-3/8	203	7-1/2	191	2
8	11-1/2	254	7-1/2	191	2
10	13-3/4	349	7-1/2	191	2-1/2
12	13-5/8	397	7-1/2	191	2-1/2
14	17-1/2	438	7-1/2	191	2-1/2

Caution: Explosion resistant terminal housings are intended to provide containment of an explosion in the enclosure only. No portion of the heater assembly outside the enclosure is covered under this NEMA rating. Abnormal use of a heater which results in excessive temperature can create hazardous conditions such as a fire. Never perform any type of service nor remove the housing cover prior to disconnecting all electrical power to the heater.